PECVD Fabrication of Carbon Cones and Helices on a Metal Tip

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Abstract

Plasma enhanced chemical vapor deposition (PECVD) is a powerful tool for synthesis of materials such as diamond, carbon nanofibers and carbon nanotubes. Its working parameters are easily tunable thus allowing us to perform various controlled process like doping, etching etc. In addition, the plasma above a substrate surface can be modulated by the substrate's shape resulting in synthesis of amazing structures by this technique. Here we report the fabrication of carbon cones and helices on iron (or nickel) tips using the PECVD method. The cones are made of concentric cylindrical graphite sheets, which have similar structures as carbon nanotubes. The stacking sequence of inner layers prefer to a graphitic ones, that is, the chirality of each inner tubes tend to be the same. Due to their unique shapes and structures, these cones are potentially good candidates as electron emission tips and scanning probes. Other structures grown on the metal tips are the carbon nanohelices which can simply be deemed as twisted carbon ribbons. Their growth obeys a tip-growth model (catalyst particles are on the tip of the nanofibers). The field emission investigations revealed a low turn-on electric field.